

High Performance Schools Workshop



Twenhofel Middle School



Robert Ehmet Hayes & Associates

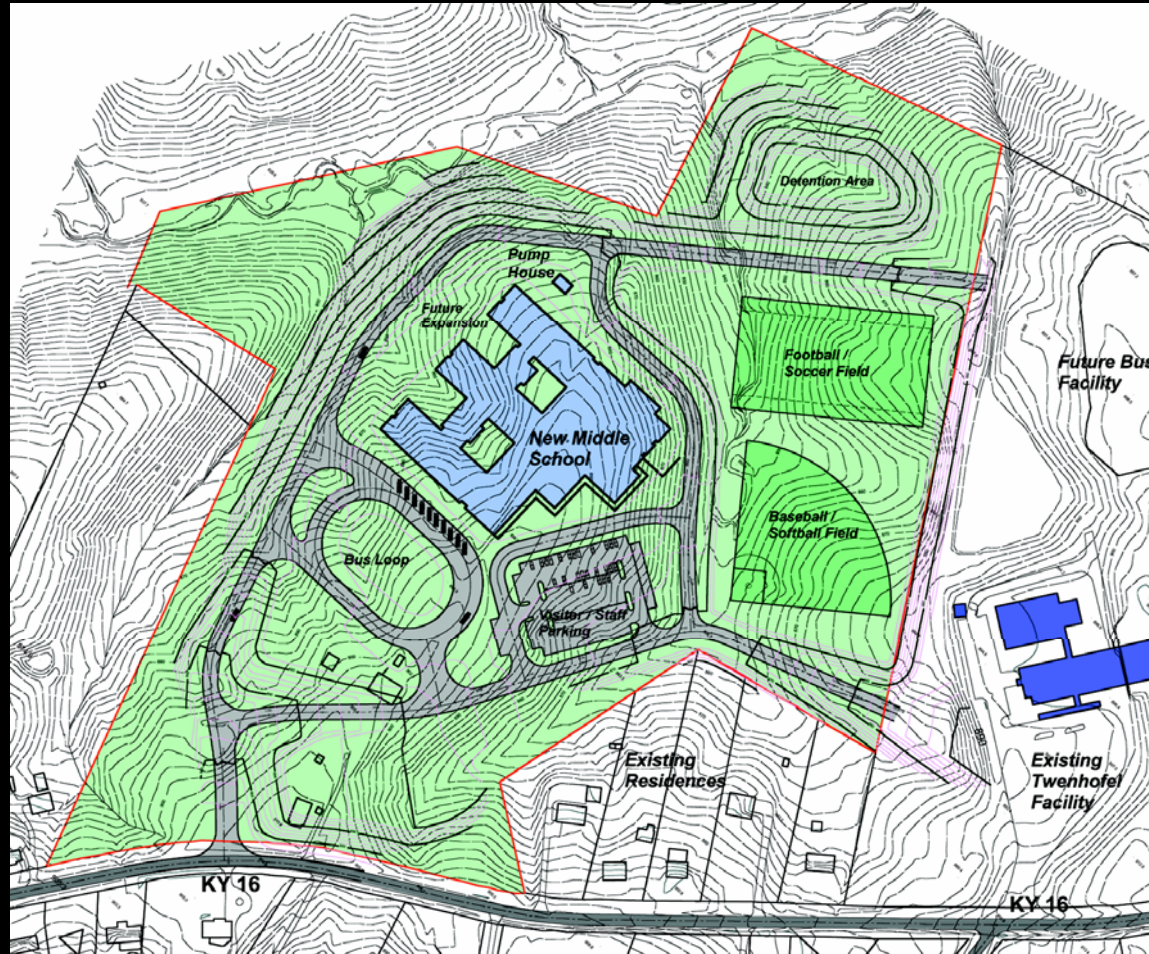
ARCHITECTS

2012 Ohio Highway - Port Mifflin, KY 40372

Since 1981

Dr. Susan K. Cook - Superintendent

Twenhofel Middle School



Robert Ehmet Hayes & Associates

ARCHITECTS

2012 Ohio Highway - Port Mifflin, KY 40372

Since 1981

Campus Plan



Twenhofel Middle School



Robert Ehmet Hayes & Associates

ARCHITECTS

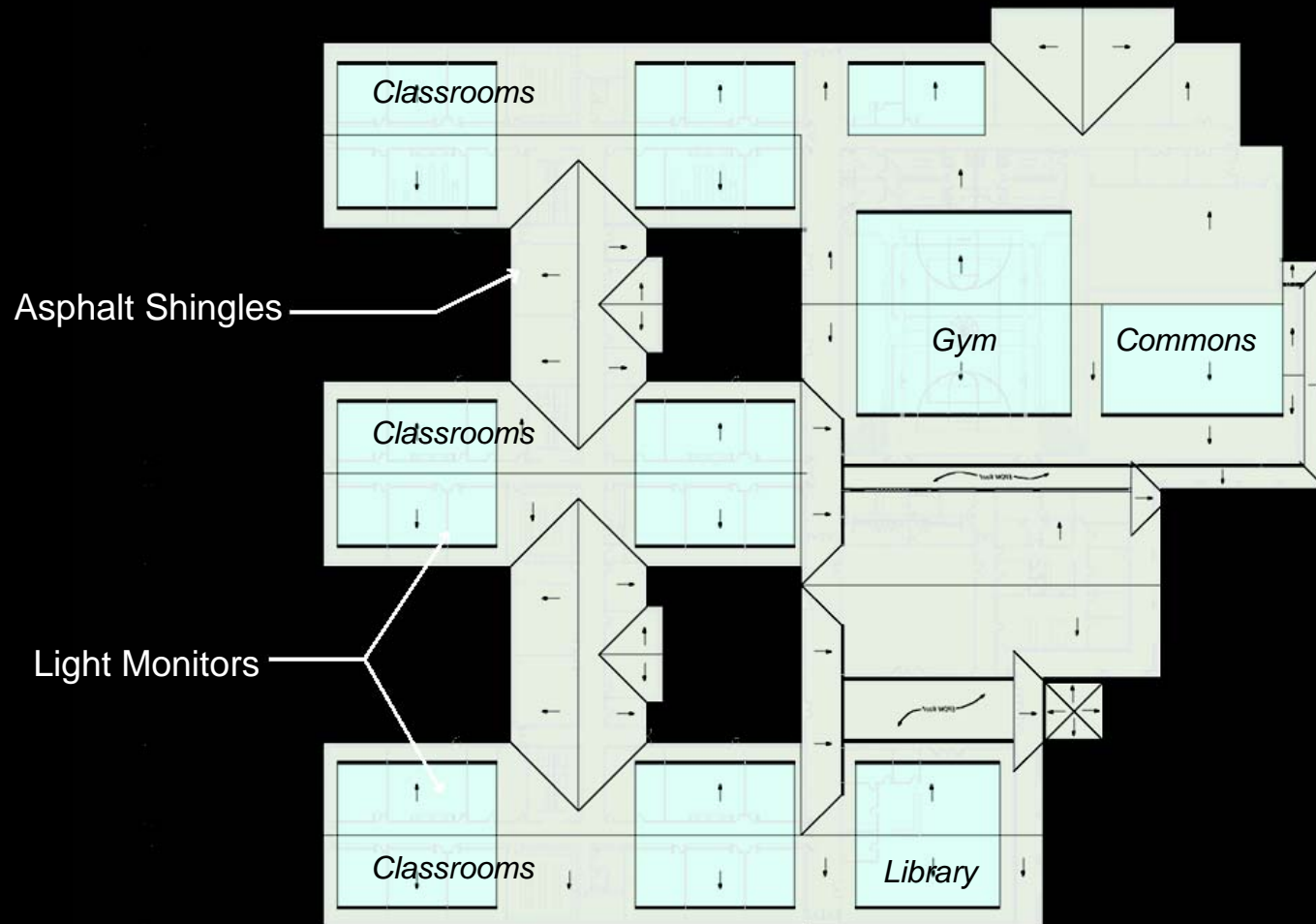
2012 Ohio Highway - Port Mitchell, KY 41052

Since 1981

Floor Plan



Twenhofel Middle School



Robert Ehmet Hayes & Associates

ARCHITECTS

2012 Ohio Highway - Port Mifflin, PA 41012

Since 1981

Roof Plan

Twenhofel Middle School



Robert Ehmet Hayes & Associates

ARCHITECTS

2012 Ohio Highway - Port William, OH 43150

Since 1981

Typical Classroom

Twenhofel Middle School



Robert Ehmet Hayes & Associates

ARCHITECTS

2012 Ohio Highway - Port Mifflin, KY 40372

Since 1981

Gymnasium

Twenhofel Middle School



Robert Ehmet Hayes & Associates

ARCHITECTS

2012 Ohio Highway - Port Mifflin, KY 41012

Since 1981

Typical Classroom

Twenhofel Middle School



Robert Ehmet Hayes & Associates

ARCHITECTS

2012 Ohio Highway - Port Mitchell, KY 41052

Since 1981

Commons & Gymnasium



Twenhofel Middle School

High Performance Schools

Benefits of High Performance

- ◆ Better student performance
- ◆ Increased average daily attendance
- ◆ Increased teacher satisfaction and retention
- ◆ Reduced energy and operating costs
- ◆ Positive influence on the environment
- ◆ Ability to use the facility as a teaching tool

Twenhofel Middle School

High Performance Design Features:



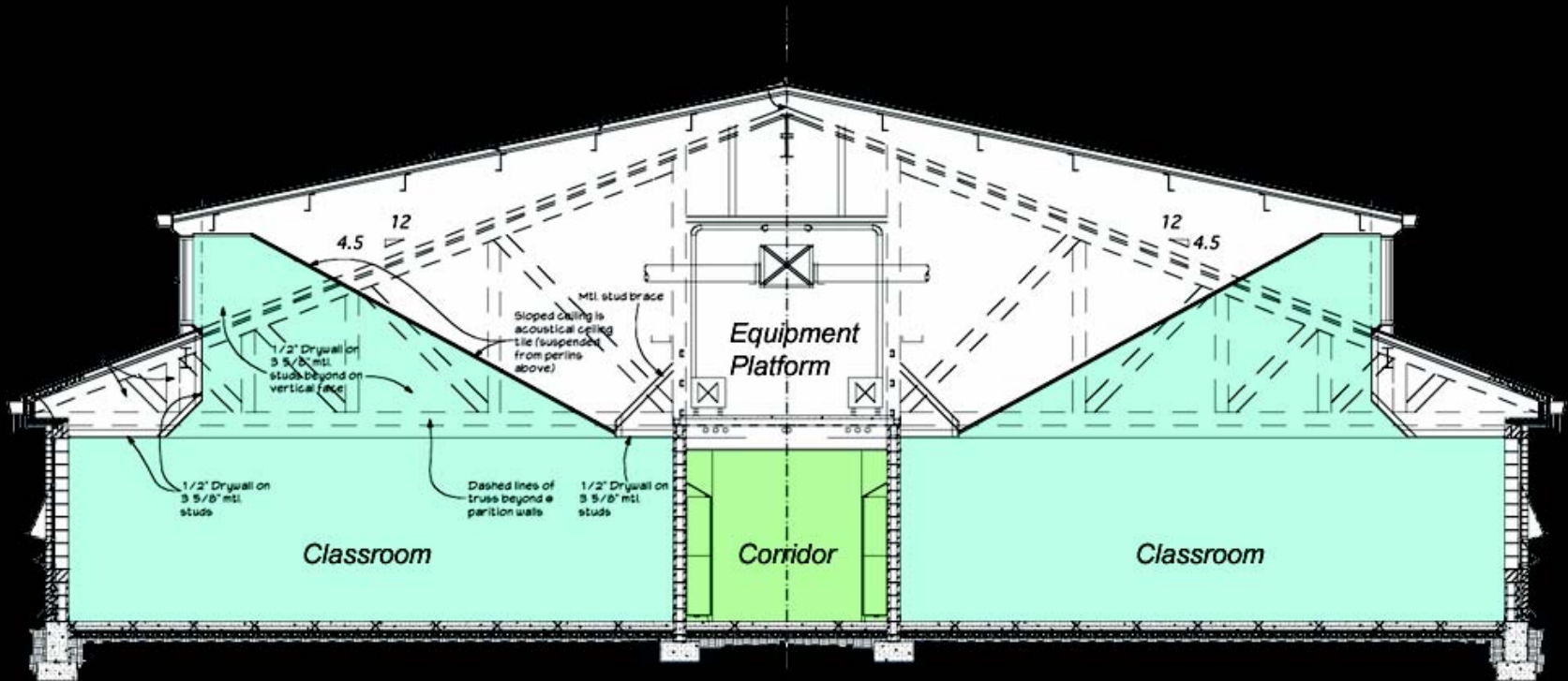
1. Daylighting Design
2. Mechanical Platform / Geothermal / Commissioning
3. Curriculum Integration
4. Rainwater Catchment System
5. Vital Signs System
6. Solar Panel Design
7. LEED Certification
8. Cost Data

Twenhofel Middle School

1) Daylighting Design

- ◆ The building is constructed on a north-south axis to provide for optimal daylighting design.
- ◆ Gymnasium, library, commons and all academic classrooms are naturally daylit with glass clearstories. They will be lit solely by natural daylight 70% of the time, thus reducing energy costs.
- ◆ Electric operated blinds are in between clearstory glass in gymnasium for it to be darkened for performances.
- ◆ Daylighting of classrooms and healthy indoor air quality are critical to providing effective learning environments.
- ◆ Studies have shown daylighting in classrooms improves student performance and increases staff satisfaction. These studies show performance increases of 20% in math and 26% in reading over a one year period.

Twenhofel Middle School



Robert Ehmet Hayes & Associates

ARCHITECTS

2012 Ohio Highway - Port Mifflin, KY 40152

Since 1981

Academic Wing Section



Twenhofel Middle School

2) Mechanical Platform / Geothermal / Commissioning

- ◆ Entire building has an industrial equipment platform above the corridors for all mechanical equipment.
- ◆ Platform serves as a concrete enclosed tornado shelter.
- ◆ Equipment can be serviced during school hours without student interruptions.
- ◆ Security personnel have direct access to classrooms from above.
- ◆ Continuous cable trays allow new and future wiring to be easily accessible.
- ◆ Three of the six science classrooms have multiple clear ceiling tiles so students can look up and see the equipment.
- ◆ Third Party Verification through Commissioning
- ◆ On Site Systems Start-up and Troubleshooting

Twenhofel Middle School



Robert Ehmet Hayes & Associates

ARCHITECTS

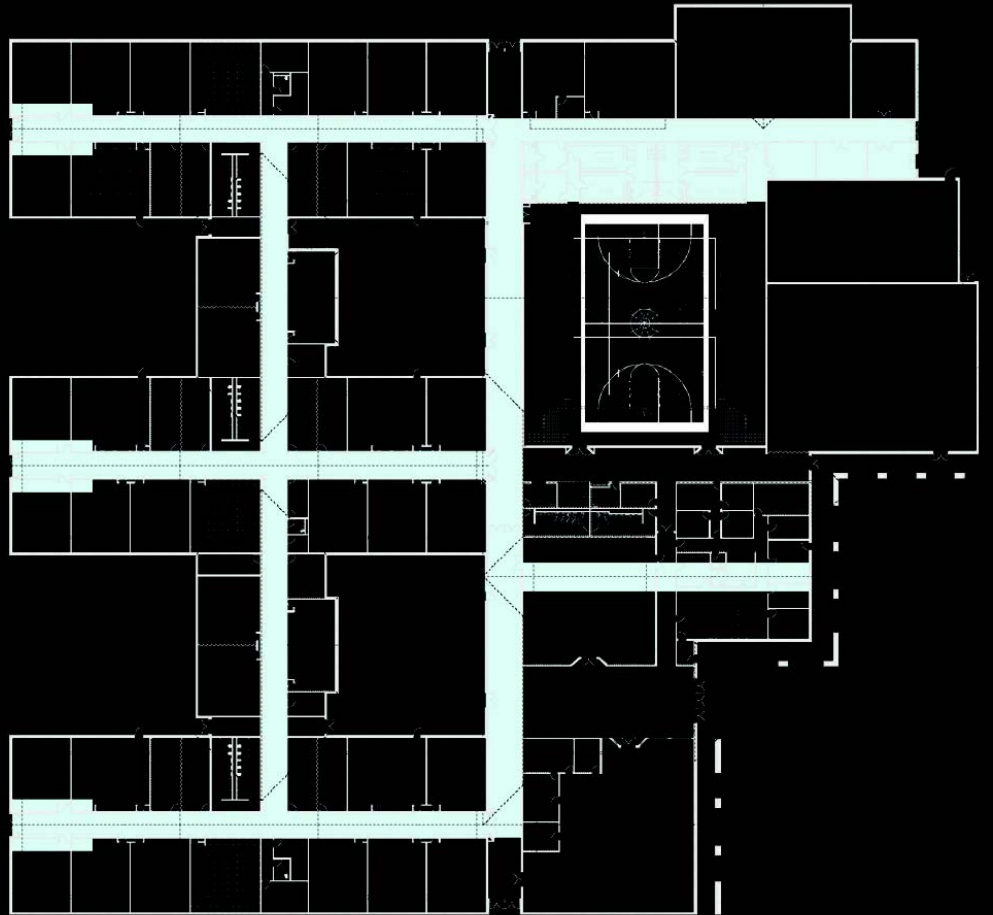
2012 Ohio Highway - Port Mifflin, NY 41012

Since 1981

Industrial Equipment Platform



Twenhofel Middle School



Robert Ehmet Hayes & Associates

ARCHITECTS

2012 Ohio Highway - Port Mansfield, OH 44861

Since 1981

Industrial Equipment Platform Plan



Twenhofel Middle School

3) Curriculum Integration

- ◆ Students can monitor electric, water, solar & geothermal usages thru the building's vital signs plasma screen in the lobby.
- ◆ Clear ceiling tiles in science classrooms allow for viewing mechanical systems.
- ◆ Clear condensation tanks in the science classrooms collect water from the heat pumps.
- ◆ Rain barrels in the courtyards show how much water is gathered from the roof and for vegetation purposes.
- ◆ Colored mechanical piping allows for easy instructional purposes.
- ◆ KY NEED and Teacher Involvement early in the Design Process.

Twenhofel Middle School

4) Rainwater Catchment System

- ◆ **Water from the entire roof is collected and then stored in a 115,000 gallon underground concrete storage tank to flush all the toilets and irrigate the football field.**
- ◆ **The two courtyards have clear rain barrels which are filled from roof water and used to irrigate the courtyard vegetation.**
- ◆ **This equipment is housed in a separate pump house on the north side of the school. Large windows and doors are provided to allow for student viewing.**

Twenhofel Middle School

5) Vital Signs System

- ◆ **Measurement of High Performance Features:**
 - Rainwater Harvesting System
 - Geothermal HVAC System
 - Solar Photovoltaic System
 - Daylight Harvesting System
 - Energy Measurement and Verification System
- ◆ **Web based access to real time data in the classroom and district wide**
- ◆ **Curriculum based data and teacher access to system**

Twenhofel Middle School

6) Solar Panel Design

- ◆ **24,000 Watt system utilizing 204 roof mounted panels tied to equipment in mezzanine**
- ◆ **Grid-tied 6000 Watt inverters for Net-metered System integrated into building A/C System**
- ◆ **UL Listed for safe operation**
- ◆ **Curriculum based DC System in Courtyard with test connectors and energy displays:**
 - Solar Powered DC Pump for Student Fountain
 - Compact Fluorescent Lamp vs. Incandescent Lamps

Twenhofel Middle School



Robert Ehmet Hayes & Associates

ARCHITECTS

2012 Ohio Highway - Port Mitchell, KY 41052

Since 1981

Solar Panels

Twenhofel Middle School

Sustainable Sites		
SS Prereq 1	Erosion and Sedimentation Control	--
SS1.0	Site Selection	1
SS4.2	Alternative Transportation - Bicycle Storage & Changing Rooms	1
SS4.4	Alternative Transportation - Parking Capacity	1
SS5.2	Reduced Site Disturbance	1
SS7.1	Heat Island Effect	1
SS6.1	Stormwater Management - Rate and Quantity	1
SS8	Light Pollution Reduction	1
Water Efficiency		
WE1.1	Water Efficient Landscaping, 50% reduction	1
WE1.2	Water Efficient Landscaping, no potable use or no irrigation	1
WE3.1	Water Use Reduction - 20% Reduction	1
WE3.2	Water Use Reduction - 30% Reduction (a lot of money for one point)	1
Energy and Atmosphere		
EA Prereq 1	Fundamental Building Systems - Commissioning	--
EA Prereq 2	Minimum Energy Performance	--
EA Prereq 3	CFC Reduction in HVAC & R Equipment	--
EA1.0-1.10	Optimize Energy Performance	3 - 4
EA3	Additional Commissioning	1
EA4	Ozone Depletion	1
EA5	Measurement & Verification	1
EA6	Green Power	1
Material and Resources		
MR Prereq.	Storage and Collection of Recyclables	--
MR2.1	Construction Waste Management - 50% Diverted	1
MR2.2	Construction Waste Management - 75% Diverted	1
MR4.1	Recycled Content - 5%	1
MR4.2	Recycled Content - 10%	1
MR5.1	Regional Materials 20% manufactured Locally	1
MR5.2	Regional Materials 50% Manufactured Locally	1
Indoor Environmental Quality		
IEQ	Minimum IAQ Performance	--
IEQ Prereq 2	Environmental Tobacco Smoke Control	--
IEQ1	Carbon Dioxide Monitoring	1
IEQ3.1	Construction IAQ Management Plan - During Construction	1
IEQ4.1-4.4	Low-Emitting Materials	4
IEQ5	Indoor Chemical & Pollutant Source Control	1
IEQ6.1-6.2	Controllability of Systems - Perimeter	2
IEQ7.1	Thermal Comfort - ASHRAE 55-1992	1
IEQ7.2	Thermal Comfort - Monitoring System	1
IEQ8.1-8.2	Daylight & Views - Daylight 75% of Spaces	2
Innovation in Design		
ID1.1	Interior Courtyard Design	1
ID1.2	Energy Classroom	
ID1.3	Education Credit	
ID1.4	Dedicated Ventilation System	1
	LEED Accredited Professional	1
	40% Water Reduction	1
	LEED Silver (33-38 points required)	41-42

Twenhofel Middle School

8) Cost Data

Project Cost - \$27,000,000

Construction Cost - \$23,530,000

Construction Cost
(Without High Performance) - \$21,071,411

\$23,530,000 / 112,000 Sq.Ft. = \$210 Sq.Ft.

1. Grading (Entire Site) - \$2,157,754

2. Exterior Lighting - \$207,225

3. Geothermal - \$670,907

4. Sewer - \$668,751

5. Bus Parking - \$560,000

6. Football Field & Concessions - \$523,000

7. Property Acquisition (Not Included) - \$900,000

High Performance Cost

1. Solar PV System - \$170,429

2. Marmoleum Flooring - \$145,500

3. Powersmith Transformers - \$38,000

4. Mechanical Platform - \$215,000

5. Technology - \$167,000

6. Vital Signs - \$60,000

7. BAS System - \$316,000

8. Daylighting - \$903,000

9. LEED - \$411,660

10. Dimming System - \$32,000

Total - \$2,458,589

LEED Totals

Commissioning - \$97,560

Plumbing Fixtures - \$30,000

CO2 Monitoring - \$11,000

Low Emitting Materials - \$10,000

Energy Classroom - \$8,000

Total LEED = - \$411,660

Rainwater Catchment - \$192,100

Ozone Depletion - \$8,000

Const. Management - \$5,000

Indoor Chemical Control - \$10,000

Courtyard Designs - \$40,000

Robert Ehmet Hayes & Associates

ARCHITECTS

2012 Ohio Highway - Port Mitchell, KY 41052 Since 1981

